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(54) Manufacturing method of hollow structural member and hollow structural member

(57) A manufacturing method of functional hollow structural member (21) comprising a structural member having a hollow part (19), and functional means (20) disposed on the inside surface of the hollow part (19), comprising a step of injecting a molding material (16) into a molding die, a step of injecting a gas (17) and a functional substance (18) into the molding material to form a hollow part in the molding material, a step of forming functional means (20) inside of the hollow part (19), and a step of forming a structural member by solidifying the molding material. As the functional means, a layer having a magnetic function, conductive function, or antibacterial function is used.

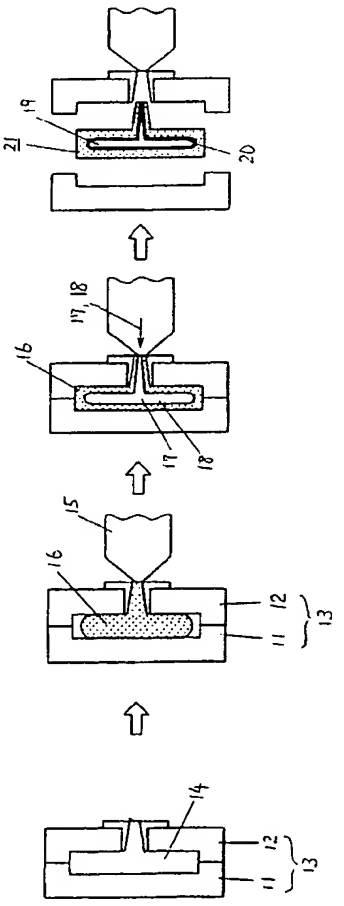

Fig. 4

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Description

Background of the Invention

Industrial Field of Utilization

The present invention relates to a hollow structural member used in a set table for mounting a television receiver (TV hereinafter). and a casing of electronic component or electronic appliance, or the like.

Prior Art

Hitherto as the structure of a set table for mounting TV or the casing of an electronic appliance. hollow structural members having a plurality of independent hollow parts or communicating hollow parts have been known.

Such hollow structural members are made of plastics. and are manufactured by gas-assisted injection molding for molding hollow parts by gas. Its purposes are saving of molding cost. reduction of weight of molded products. improvement of quality, and molding at low pressure. Fig. 15 shows an outline of processing chart of a conventional manufacturing method of hollow structural member. In Fig. 15. molten plastic 103 is poured in between a first die 101 and a second die 102. By injecting gas 104 into the molten plastic 103, a hollow part 105 is formed. Then it is solidified by cooling. The solidified hollow structural member 106 is taken out from the first die 101 and second die 102

To manufacture structural members having conductive layers. the following methods are known.

(a) A method of applying a conductive paint on an outer surface of a solid box or a hollow structural member.
(b) A method of forming a thin conductive metal film by vapor deposition. plating or sputtering, on an outer surface of a solid box or a hollow structural member.
(c) A method of adhering a thin conductive metal plate, on an outer surface of a solid box or a hollow structural member.
(d) A method of forming a conductive structural member, by injection molding of a material of compound plastics containing a conductive filler.
(e) A method of injection molding a hollow structural member, injecting a liquid conductive substance into the hollow part of a solidified structural member, and drying the liquid substance, thereby depositing a conductive layer.

In methods (a) to (c), it is hard to obtain a structural member of complicated shape, and therefore they cannot be flexibly applied to varied designs of the casing for composing electronic appliances. Besides, these methods required many processes, and the cost cannot be lowered

In method (d), the resin flowability is poor, and the molding performance and surface state of molded product are poor.

A manufacturing process chart of method (e) is shown in Fig. 16.

(1) First, molten resin is injected into the die.
(2) Then, gas is injected before the molten resin is solidified, and a hollow part is formed.
(3) The molten resin forming a hollow part is solidified.
(4) Next, a conductive liquid paint is injected into the solidified hollow part.
(5) The conductive liquid paint is cured by heating.
(6) The solidified resin forming the conductive paint in the hollow part is taken out of the die.

In method (e), after the molten resin injected into the die is cooled and solidified, a conductive liquid is poured into the hollow part, and it requires the time for drying the liquid injected into the hollow part, in addition to the time of solidifying the resin poured into the die. Therefore, the molding cycle is long, and the productivity is poor.

It is hence an object of the invention to present a manufacturing method of hollow structural member capable of obtaining a molded product having an excellent surface state and a superior appearance, and shortening the molding cycle at the same time, and having the function for manufacturing easily and at low cost

Summary of the Invention

A manufacturing method of hollow structural member of the invention comprises the steps of:

(1) pouring a molding material into a die,
(2) injecting gas into the material to form a hollow part in the material,
(3) injecting a substance having a function into the hollow part of the material to form functional means inside the hollow part,
(4) solidifying the material having the hollow part to form a structural member, and
(5) taking out the solidified structural member containing the functional means formed inside of the hollow part, from the die.

Other manufacturing method of hollow structural member of the invention comprises the steps of:

(1) pouring a molding material into a die,
(2) injecting gas into the material to form a plurality of hollow parts in the material,
(3) injecting a substance having a function into the plurality of hollow parts of the material to form functional means inside the hollow part,
(4) solidifying the material having the hollow parts to form a structural member, and

(5) taking out the solidified structural member containing the functional means formed inside of the hollow parts, from the die.

In the manufacturing method. the structural member is not particularly defined, but thermoplastic plastic, thermosetting plastic, rubber, inorganic mater, ceramics, compound plastic containing filler, and others may be used.

The molding material is a starting material of the structural member. For example, in the case of thermoplastic plastic, the material is in molten state by heating. In the case of thermosetting plastic, the material is in fluid state. In the case of inorganic matter or ceramics, the material is a mixture of powder of inorganic substance and solvent. In the case compound plastic containing filler, the material is in fluid state.

Gas is injected into the material before the material is solidified.

The substance having a function is injected into the material before the material is solidified. As the substance having a function, magnetic substance, conductive substance, antibacterial substance or the like may be used.

The timing of injecting the substance having a function into the material is not particularly defined. For example, the substance having a function is injected as a mixture mixed in gas. Or the substance having a function is injected together with gas from different nozzles. Or the substance having a function is injected before or after injection of gas.

The shape of the plurality of hollow parts is not particularly defined, but cross form such as x-shape and + shape, Y form, tee form, concentric form, radial form, and other forms mutually isolated by partition wall or the like are preferred.

A different manufacturing method of hollow structural member comprises the steps of:

(1) forming a first structural member having a first half for forming a portion of a hollow part, by using a first die having a first fixed die and a first movable die,

(2) forming a second structural member having a second half for forming a portion of the hollow part, by using a second die having a second fixed die and a second movable die,

(3) forming first functional means inside of the first half,

(4) forming second functional means inside of the second half,

(5) moving the second movable die to the first fixed die, thereby combining the first structural member having the first functional means and the second structural member having the second functional means so as to form the hollow part by the first half and second half, and forming the first structural member and second structural member into one body to as to form a third structural member and

(6) taking out the third structural member containing the first functional means and second functional means formed inside of the hollow part, from the first fixed die and second fixed die.

By such manufacturing method, a molded product having an excellent surface state and superior appearance can be obtained, and at the same time, moreover, the molding cycle is short, and the hollow structural member having the functional performance can be manufactured easily and at low cost. In particular, excellent effects are obtained when manufacturing a structural member having a plurality of hollow parts and forming functional means on the surface of each hollow part.

Brief Description of the Drawings

Fig. 1 is a process chart showing an embodiment of manufacturing method of a hollow structural member of the invention.

Fig. 2 is a process chart showing other embodiment of manufacturing method of a hollow structural member of the invention.

Fig. 3 is a process chart showing a different embodiment of manufacturing method of a hollow structural member of the invention.

Fig. 4 is an explanatory diagram showing a further different embodiment of the invention, particularly showing a manufacturing method by injection molding.

Fig. 5 is a process chart showing other different embodiment of manufacturing method of a hollow structural member of the invention.

Fig. 6A is a plan view of a hollow structural plate manufactured by an embodiment of the invention.

Fig. 6B is a sectional view of the hollow structural plate shown in Fig. 6A.

Fig. 6C is a sectional view for explaining the forming process of the hollow structural plate shown in Fig. 6A.

Fig. 6D is a sectional view of the hollow structural plate manufactured in Fig. 6C.

Fig. 6E is a plan view seen from the direction of section line S5-S5 shown in Fig. 6D.

Fig. 7 is a process chart showing a still different embodiment of manufacturing method of a hollow structural member of the invention.

Fig. 8 is a process chart showing a still other embodiment of manufacturing method of a hollow structural member of the invention.

Fig. 9 is a perspective exploded view before assembly of a television receiver stand using a hollow structural member manufactured by an embodiment of the invention.

Fig. 10A is a plan view of a hollow structural member obtained by an embodiment of the invention.

Fig. 10B is a sectional view from the direction of section line S1-S1 shown in Fig. 10A.

Fig. 11A is a plan view of a hollow structural member

obtained by other embodiment of the invention.

Fig 11B is a sectional view from the direction of section line S2-S2 shown in Fig. 11A.

Fig. 12A is a plan view of a hollow structural member obtained by a different embodiment of the invention.

Fig. 12B is a sectional view from the direction of section line S3-S3 shown in Fig. 12A.

Fig. 13A is a plan view of a hollow structural member obtained by a further different embodiment of the invention.

Fig. 13B is a sectional view from the direction of section line S4-S4 shown in Fig. 13A.

Fig. 14A is a plan view of a hollow structural member obtained by a still different embodiment of the invention.

Fig. 14B is a magnified sectional view of a base part of Fig. 14A.

Fig. 15 is a process chart showing a conventional manufacturing method of hollow structural member.

Fig. 16 is a process chart showing other conventional manufacturing method of hollow structural member.

Description of the Preferred Embodiment

Referring now to the drawings, some of the embodiments of the invention are described in detail below.

Embodiment 1-1

Fig. 1 shows an outline of manufacturing process in an embodiment of manufacturing method of hollow structural member of the invention. In Fig. 1, it is characterized by:

(1) pouring a molding material into a cavity of a die,
(2) injecting a mixed gas of a substance having a function and a gas before the material is solidified, thereby forming a hollow part in the material and simultaneously forming functional means on the inner surface of the hollow part,
(3) solidifying the material forming the hollow part, and
(4) taking out the solidified structural member forming the functional means in the hollow part, from the die.

Embodiment 1-2

Fig. 2 shows an outline of manufacturing process in other embodiment of manufacturing method of hollow structural member of the invention. In Fig. 2, it is characterized by:

(1) pouring a molding material into a cavity of a die,
(2) injecting a substance having a function and a gas simultaneously and separately from different nozzles before the material is solidified, thereby forming a hollow part in the material and simultaneously forming functional means on the inner surface of the hollow part,
(3) solidifying the material forming the hollow part and
(4) taking out the solidified structural member forming the functional means in the hollow part, from the die.

Embodiment 1-3

Fig. 3 shows an outline of manufacturing process in another embodiment of manufacturing method of hollow structural member of the invention. In Fig. 3, it is characterized by:

(1) pouring a molding material into a cavity of a die,
(2) injecting a gas before the material is solidified, thereby forming a hollow part in the material,
(3) injecting a substance having a function into the hollow part before the material is solidified, thereby forming functional means on the inner surface of the hollow part,
(4) solidifying the material forming the hollow part, and
(5) taking out the solidified structural member forming the functional means in the hollow part, from the die.

Embodiment 2

Relating to embodiments 1-1, 1-2 and 1-3, a manufacturing method by gas-assisted injection molding using thermoplastic plastic as material is described in a further specific embodiment. Fig. 4 is a diagram explaining an outline of a manufacturing method of hollow structural member by injection molding. In Fig. 4, first, a molten resin 16 is poured from a nozzle 15 into a cavity 14 of a molding die 13 composed of a fixed die 11 and a movable die 12. The die 13 is structured so as to form one hollow part of a simple shape, or one hollow part communicating in a complicated shape, or a plurality of internally independent hollow parts by partition plates (partition walls) or the like crossing in a cross or tee form. An insufficient amount of molten resin 16 for filling up the cavity 14 is poured into the cavity 14. In succession, from the same nozzle 15, a gas 17 and a functional substance 18 are poured in. In this case, by injecting the gas 17 while injecting the molten resin 16, the cavity 14 can be fully filled up with the molten resin 16. Or, after injecting the gas 17, the molten resin 16 can be further injected. The timing of injecting the functional substance into the inside of the hollow part is arbitrary. That is, it is also possible to feed in a form of a mixed gas mixing the functional substance 18 into the gas 17 for forming the hollow part. Or, the gas 17 and the functional substance 18 can be poured at the same time. Moreover, the functional substance 18 can be injected before or after injection of the gas 17. The nozzle for injecting the molten resin 16, gas 17 or functional substance 18 may be arbitrarily disposed

at plural positions, not limited to one position. Still more, the nozzle for injecting the molten resin 16, the nozzle for injecting the gas 17, and the gas for injecting the functional substance 18 may be either shared, or disposed independently. Afterwards, the molten resin 16 having a hollow part 19 and functional means 20 formed on the inner surface of the hollow part 19 is cooled and solidified. Finally, a solidified structural member 21 having the hollow part 19 and the functional means 20 formed on the inner surface of the hollow part 19 is taken out of the die 13.

Embodiment 3

In the gas-assisted injection molding technique of embodiment 2, the following die composition may be employed as the means for disposing a plurality of independent hollow parts. That is, together with gas assisting, in order to form crossing partition walls in cross form such as X shape and + shape, Y form, tee form, plural partition platesor pins are incorporated in the movable die 12 so as to be free to move in and out. In this case, too, the timing of injecting the functional substance 18 into the inside of the hollow part 19 is arbitrary. That is, it is also possible to feed in a form of a mixed gas mixing the functional substance 18 into the gas 17 for forming the hollow part. Or, the gas 17 and the functional substance 18 can be poured at the same time. Moreover, the functional substance 18 can be injected before or after injection of the gas 17. Or, before forming the partition wall, by forming the functional means 20 preliminarily inside of the hollow part 18 and the composing the partition walls crossing in cross form or tee form, if the hollow parts 18 are individually independent, the functional means 20 formed in these hollow parts 18 are mutually connected.

Embodiment 4

Fig. 5 shows an outline of a manufacturing process in a further different embodiment of a manufacturing method of hollow structural member of the invention. In Fig. 5, it is characterized by:

(1) forming a first structural member having a first half for forming a portion of a hollow part, by using a first die having a first fixed die and a first movable die,
(2) forming a second structural member having a second half for forming a portion of the hollow part, by using a second die having a second fixed die and a second movable die,
(3) forming first functional means inside of the first half,
(4) forming second functional means inside of the second half,
(5) moving the second movable die to the first fixed die, thereby combining the first structural member having the first functional means and the second structural member having the second functional means so as to form the hollow part by the first half and second half, and forming the first structural member and second structural member into one body to as to form a third structural member, and
(6) taking out the third structural member , from the first fixed die and second movable die.

Embodiment 5

Relating to embodiment 4, a further specific embodiment is described below. In the forming method. herein, primary molding and secondary molding are effected by one die. Moreover, between the primary molding step and secondary molding step, another step is inserted for forming functional means. That is, when manufacturing an integral structure composed by disposing a plurality of independent hollow parts inside by partition plates (partition walls) crossing in cross form or tee form, first, each half portion is injection molded in primary molding by one molding die. In consequence, in order to dispose functional means inside of the hollow parts, functional means is disposed on the concave part side surface and joining surface sides for forming the hollow parts of the individual half portions. The functional means is disposed on the surface of the hollow parts by any means, such as functional substance spraying method, inject, tampon printing or other transfer method. The injection molding dies forming the half portions are combined by mutually sliding at the fixed side and movable side, and by performing secondary molding in the combined state, the half portions are combined by the use of the material resin for secondary molding, so as to be formed into one body.

This embodiment is further described below while referring to Fig. 6A to Fig.6E. Fig. 6A is a plan view of a hollow structural member manufactured in embodiment 5, and Fig. 6B is its front view. In Figs. 6A and 6B, a hollow structural plate 300 is composed by coupling two hollow structural plates formed by primary molding, a first half 301 and a second half 302, by a second resin member 400. Inside of the structural plate 300, a plurality of independent first hollow parts 303 and second hollow parts 304 are neatly arranged. These hollow parts 303, 304 are isolated from each other by the partition wall 305. Functional means 100 is disposed in side of each hollow part in a specific film or layer form.

Fig. 6C is a sectional view for explaining the molding process of the hollow structural member of the embodiment, Fig. 6D is a sectional view of a manufactured hollow structural member, and Fig. 6E is a plan view of the surface being cut off along the section S5 shown in Fig. 6D. In Figs. 6C, 6D and 6E, to begin with, the first half 301 having holes 303a, 304a is formed by a first die composed of a first fixed die and a first movable die. In consequence, the functional means 100 is disposed on the surface of the holes 303a, 304a. On the other hand, by

a second die composed a second fixed die and a second movable die, the second half 302 is formed. The functional means 100 is disposed in a specified area of the second half 302. Grooves 307 are formed in the end circumferences of the first half 301 and second half 302, and a stepped recess 306 is formed at the end of the partition wall 305. Then, in order that the groove 307 and stepped recess 306 may be matched, the second half 302 in the second movable die is combined with the first half 301 in the first fixed die. Secondary molding is done by injecting a resin member into the groove 307 and stepped recess 306 of the combined first half 301 and second half 302. Thus, the first half 301 and second half 302 are combined into one body. In this manner, the hollow structural member is manufactured of the plurality of the first hollow parts 303 and second hollow parts 304 mutually partitioned by the partition wall 305, and the functional means 100 disposed on the surface of these hollow parts 303, 304.

Embodiment 6

Fig. 7 is a diagram explaining a different manufacturing method of hollow structural member of the invention, showing the outline of a process of hollow structural member of compound plastics, by using compound resin containing conductive filler or magnetic filler. In Fig. 7, it is characterized by:

(1) injecting a material of compound resin containing conductive filler or magnetic filler into a cavity of a die,
(2) injecting a functional substance and a gas before the material is solidified, thereby forming a hollow part in the material, and simultaneously forming functional means on the inside surface of the hollow part,
(3) solidifying the material forming the hollow part, and
(4) taking out the solidified structural member forming the functional means in the hollow part, from the die.

Embodiment 7

An embodiment of using ceramics as a structural member is described below. Fig. 8 shows a manufacturing process of hollow structural member according to a further different embodiment of the invention, which comprises the steps of:

(1) mixing ceramics powder mixing silicon nitride, alumina, and yttria, an organic solvent such as alcohol, paraffin or hydrocarbon, a dispersant such as polyethylene alkyl ether phosphate or polyethylene glycol alkyl ether, and a gelling agent of fatty acid containing hydroxy group,
(2) pouring a material their mixture into a die,
(3) injecting a mixed gas of ferrite powder and nitrogen gas into the mixture in the die, thereby forming a hollow part, and simultaneously forming a functional film on the surface of the hollow part.
(4) heating to about 500 deg. C to solidify the material, and
(5) sintering, thereby obtaining a hollow structural member having a magnetic layer in the hollow part.

In the invention, aside from the gas-assisted injection molding method or the method of performing primary molding and secondary molding by using one die explained in the foregoing embodiments, any arbitrary hollow part forming method may be employed.

The functional means is not particularly defined, but, for example. magnetic member, conductive member, antibacterial member, or stiff member may be composed.

The magnetic member is not particularly defined, but, for example, soft magnetic material such as iron oxide and ferrite, stiff magnetic material such as barium ferrite and strontium ferrite, magnetic metal such as iron, silicon and nickel, and magnetic alloy such as iron-nickel, iron-silicon, iron-cobalt. and iron-aluminum can be used. The material of such magnetic member is used in powder or fiber form, and by injecting a gas containing such magnetic powder into the hollow part, a magnetic layer is disposed on the inside of the hollow part. Or by spraying a paint mixing the magnetic powder with binder, solvent or other resin member, a magnetic coat film is formed The magnetic layer or magnetic member of such magnetic layer absorbs electromagnetic waves from outside, and works to attenuate or extinguish the electromagnetic waves.

The conductive member is not particularly defined, but, for example, silver, copper, brass, iron, zinc, aluminum, nickel, stainless steel, or carbon may be used. The material of such conductive member is used in powder or fiber form, and by injecting a gas containing such conductive powder into the hollow part, a conductive layer is disposed on the inside of the hollow part. Or by spraying a paint mixing the conductive powder with binder, solvent or other resin member, a conductive coat film is disposed on the inside of the hollow part. The conductive layer or conductive member of such conductive layer works to reflect the electromagnetic waves from outside.

The shape of the material of magnetic member or conductive member is not particularly defined, but, for example, size and shape suited to mixing with high pressure gas, or size and shape suited to containing conductive paint may be employed. The thickness of the layer of the functional means disposed on the surface of the hollow part is not particularly defined, but it may be, for example, 1 micrometer or more. Especially when used as the means for shielding the electromagnetic waves, the thickness of the conductive member is desired to be about 1 micrometer or more, and the thickness of the conductive member is preferred to be about 10 micrometers or more.

The particle size of the powder is not particularly defined, but, for example, it may be about 0.1 micrometers to about 100 micrometers, and especially about 0.5 micrometers to about 20 micrometers may be preferred. The diameter of fiber is not particularly defined, but, for example, about 1 micrometer to 100 micrometers may be preferred. The length of fiber is not particularly defined, but, for example, about 0.5 millimeters to about 10 millimeters may be preferred.

As the antibacterial member, antibacterial zeolite, chitosan, tannin, or tropylone may be used. The antibacterial zeolite contains bactericidal substance such as silver copper and zinc in its fine pores, and is effective to cut off the survival environments for the depositing bacteria. When added to plastics such as polypropylene, it is effective by adding by several percent. Chitosan is contained in the shells of crabs and shrimps, and possesses antibacterial and antifungal activities. When added to plastics, it is effective at about 0.3% to about 3%. Powder with particle size of about 5 micrometers or less is used. Tannin is contained in mugwort, and has antiallergic or analgesic effect. Chlorophyll is contained in plant, and has a bactericidal effect. A microcapsule of particle size of about 0.5 micrometers to about 20 micrometers containing extract of mugwort is used. Tropylone is contained in hinoki cypress, and has a preservative effect to prevent bacteria or fungi. A microcapsule containing tropylone is used.

Moreover, the conductive paint may be mixed with arbitrary solvent such as alcohol, toluene, thinner and acetone, or with PVA (polyvinyl alcohol), or the like. The conductive paint may also contain a specified amount of desired resin member, such as epoxy resin, acrylic resin, vinyl chloride resin, ABS resin, PS resin, polyamide resin, polycarbonate resin, styrene resin, or other thermoplastic resin.

In gas-assisted injection molding of hollow structural member, the gas to be blown for forming the hollow part is not particularly defined, but, for example, nitrogen, carbon dioxide, air or other inert gas may be used. At the same time, a substance having a boiling point below the ordinary temperature or a substance liquefied at high pressure may be also used.

The material of hollow structural member is not particularly defined, but, for example, thermoplastic plastic, thermosetting plastic, rubber, inorganic matter, ceramics, and compound plastic containing filler may be used. For example, as the thermoplastic plastic, polypropylene, polystyrene, ABS resin, polyethylene, acrylic resin, and polyethylene terephthalate may be used. Usable examples of thermosetting plastic include phenol resin, epoxy resin, melamine resin, and polyester fiber. As the rubber, silicone rubber, butadiene rubber, butyl rubber, fluorine, copolymerization rubber or others may be used. As ceramics, False Stellite, alumina, silicon nitride or others may be used, and as the material, mixtures of ceramics powder with solvent, organic binder, surfactant, thickener and others may be used. As the solvent, water, polyvinyl alcohol, alcohol, toluene or others may be used. The compound plastic containing filler may include plastics mixing powder of silica, alumina, calcium carbonate. glass fiber, balloon (hollow matter made of glass, metal, ceramics, etc.) or others. In particular, the compound plastic containing balloon is effective for reducing the weight. Biodegradable plastics include, for example, denatured protein member such as gluten, kneaded member of paper and denatured protein, agar member, member of potato starch kneaded in water, natural high polymer novamont (tradename Materbie of Nippon Gosei Kagaku), microorganism producing polyester system ICI (tradename Biopole of ICI Japan). chemically synthesized aliphatic polyester (tradename Vionolet of Showa Kobunshi) and others.

By the above manufacturing method, molded products having excellent surface state and superior appearance can be obtained, and at the same time the molding cycle is short, and hence the hollow structural member having a functional property can be manufactured easily and at low cost. In particular, excellent effects are obtained when manufacturing a structural member having a plurality of hollow parts, and forming functional means on the surface of the hollow parts. Besides, the characteristics of the resin member used in injection molding are not altered. For example, without changing the molding properties of the resin member, arbitrary structures and curved shapes can be composed depending on the diversity of design and purposes of use. The functional means can be composed only in a necessary region of the structural member. Moreover, since the hollow part and functional means can be formed simultaneously, the material cost or manufacturing processes can be reduced.

Embodiment 8

To obtain a set stand having a function of mounting an electronic appliances such as television receiver and shielding electromagnetic waves (hereinafter called TV stand), an embodiment of manufacturing method of hollow structural member of the invention is described below. Fig. 9 is a perspective exploded view before assembly of the TV stand using a hollow structural member obtained from the manufacturing method in an embodiment of the invention. In Fig. 9, the TV stand is composed of five hollow structural members, that is, bottom plate 11, top plate 12, side plates 13, and rear plate 14, and these hollow structural members are mutually coupled by coupling screws 15 and assembled. Inside the TV stand, the video tape recorder (VTR), BS tuner, CS tuner and other electronic appliances are accommodated (not shown).

Electromagnetic waves from outside are shielded by this TV stand. At the four corners of the hollow structural member composing the bottom plate 11, top plate 12 and rear plate 14, stepped penetration holes 72 considering positioning between members are disposed at four points. The plurality of hollow parts formed in the struc-

tural members are formed at positions not affecting the strength, close to the stepped penetration holes 72

Figs. 10 to 14 show various embodiments of the hollow structural member of the invention. The hollow structural members of the illustrated embodiments are manufactured by gas-assisted injection molding, or integral molding by primary molding and secondary molding. The hollow structural member manufactured by integral molding has one hollow part of a plurality of hollow parts in its inside, and an electromagnetic wave shielding member is formed inside of the hollow part in a film or layer form.

Embodiment 8-1

Fig. 10A and Fig. 10B show one embodiment of the invention, and Fig. 10A is a plan view of a hollow structural member composing the top plate of the TV stand, and Fig. 10B is a sectional view seen from the direction of line S1-S1 of Fig. 10A. The top plate 21 is intended to reduce the weight and function to cut off electromagnetic waves. In the portion requiring a large strength, that is, in the portion located below the base part 2 of the television receiver 1 and receiving its load, a hollow part 23 having a small volume is formed, and in the portion not directly provided with load, a hollow part 22 having a large volume is formed, and the small hollow part 22 and large hollow part 23 are disposed in specific shapes by mutually crossing partition walls 24. In this embodiment, by symmetrically disposing three types of hollow parts differing in size, the weight of the top plate 21 is reduced. At the inner side of the small hollow part 22 and large hollow part 23, conductive members 100 having electromagnetic wave shielding function are displayed in a thin film or layer form. The means for disposing the conductive members 100 can be formed in one of the foregoing embodiments 1 to 6. By keeping the total occupancy of the hollow parts in a range of 20 to 90% of the volume of the outer circumference of the top plate 21, the resin material is saved, and the cost is lowered. The rate of total occupancy of the hollow parts may be determined depending on the purpose of use, required strength and resin material for composing the hollow structural member. To form a plurality of independent hollow parts, as shown in Fig. 10A, partition walls are formed in a cross form or tee form, but the partition walls are not limited to cross form or tee form, but partition walls may be constituted in arbitrary forms.

Embodiment 8-2

Figs. 11A and 11B show other embodiment of the invention, and Fig. 11A is a plan view of a hollow structural member for composing the top plate, bottom plate or side plates of the TV stand, and Fig. 11B is a sectional view seen from direction of line S2-S2 of Fig. 11A. The hollow structural member shown in Figs. 11A and 11B is reduced in weight, and has a radial hollow part 35. In the structural member having a radial hollow part, when the load is applied almost uniformly on the entire surface of the structural member, the stress is uniformly dispersed, and as a result the molded piece is free from warp or deflection. Electromagnetic wave shielding means 100 is disposed at specified position at the inner side of the hollow part 35.

Embodiment 8-3

Figs. 12A and 12B show other embodiment of the invention, and Fig. 12A is a plan view of a hollow structural member for composing the top plate, bottom plate or side plates of the TV stand, and Fig. 12B is a sectional view seen from direction of line S3-S3 of Fig. 12A. The hollow structural member shown in Figs. 12A and 12B is reduced in weight, and has concentric hollow parts. The concentric hollow parts consist of, concentrically from the center to the outer circumference, a circular hollow part 41, annular hollow parts 42, 43, and arcuate hollow parts 44, 45. In the structural member having concentric hollow parts, when the load is applied to the center of the structural member, the stress is uniformly dispersed, so that the molded piece is free from warp or deflection. Electromagnetic wave shielding means 100 is disposed at specified position at each inner side of the circular hollow part 41, annular hollow parts 42, 43, and arcuate hollow parts 44, 45.

Embodiment 8-4

Figs. 13A and 13B show other embodiment of the invention, and Fig. 13A is a plan view of a hollow structural member for composing the top plate, bottom plate or side plates of the TV stand, and Fig. 13B is a sectional view seen from direction of line S4-S4 of Fig. 13A. The hollow structural member shown in Figs. 13A and 13B is reduced in weight, and has four reinforcing ribs. The four reinforcing ribs 52 disposed in the center are composed so that the peripheral side wall thickness 51 may be greater than the wall thickness of the reinforcing ribs 52 when a load is applied to the peripheral edge of the structural member. The reinforcing ribs 52 prevent warp, deflection or shrinkage of the molded piece. At the inner side of the hollow part, electromagnetic wave shielding means 100 is disposed at specified position.

Embodiment 8-5

Figs. 14A and 14B show a different embodiment of the invention, and Fig. 14A is a side view of a TV stand mounting the television receiver, and Fig. 14B is a magnified sectional view of base part of Fig. 14A. At specified positions of a hollow structural member composing a bottom plate 151 of TV stand, an elastic base part 156 for absorbing vibration from outside is disposed at four positions. The elastic base part 156 has a hollow part 154 of a nearly T-shape section at four corners of the bottom

plate 151. The elastic base part 156 has arcuate thin wall parts 155 formed symmetrically in order to have an elasticity of same function as compression spring. When vibration is given from outside, by deflecting in the arrow direction from the broken line position to the solid line position, the vibration is absorbed or alleviated. At the inner side of the hollow parts 154, 157, electromagnetic wave shielding means 100 is disposed at specific positions

Thus, according to embodiments 8-1 to 8-5, the TV stand having excellent electromagnetic wave shielding means and excellent in mechanical strength against load from outside is obtained.

Besides, by setting the size and shape of the hollow parts as specified, a required mechanical strength can be obtained as desired by varying the value in every position of the same structural member.

Besides, because of integral molding, joining or assembling parts is not needed.

In the foregoing embodiments, the hollow structural members for composing the TV stand are described, but the application is not limited to the TV stand only. For example, the invention may be applied to the box for accommodating electronic components, devices or other electronic appliances.

Claims

1. A manufacturing method of hollow structural member comprising:

   (a) a step of pouring a molding material into a die,
   (b) a step of injecting gas into the material to form a hollow part in the material,
   (c) a step of injecting a substance having a function into the hollow part of the material to form a functional means inside the hollow part,
   (d) a step of solidifying the material having the hollow part to form a structural member, and
   (e) a step of taking out the solidified structural member containing the functional means formed inside of the hollow part, from the die.

2. A manufacturing method of hollow structural member of claim 1, wherein before the material is solidified, the gas is injected to form the hollow part in the material, and the substance having the function is injected to form the functional means inside of the hollow part.

3. A manufacturing method of hollow structural member of claim 1, wherein the structural member is composed of at least one kind selected from the group consisting of thermoplastic plastic, thermosetting plastic, rubber, inorganic material, ceramics, compound plastic containing filler, and biodegradable plastic.

4. A manufacturing method of hollow structural member of claim 1, wherein the molding material is composed of a thermoplastic resin, and the molding material is fused by heating.

5. A manufacturing method of hollow structural member of claim 1, wherein the hollow structural member is formed by injection molding method.

6. A manufacturing method of hollow structural member of any one of the preceding claims, wherein at steps (b) and (c), by injecting the gas and the substance having the function separately at the same time, the hollow part is formed inside the material, and the functional means is formed inside of the hollow part simultaneously.

7. A manufacturing method of hollow structural member of any one of claims 1 to 6, wherein at steps (b) and (c), by injecting a mixed gas of the gas and the substance having the function, the hollow part is formed inside the material, and the functional means is formed inside of the hollow part simultaneously.

8. A manufacturing method of hollow structural member of any one of the preceding claims, wherein the functional means is at least one selected from the group consisting of thin film, layer, and multiple layers.

9. A manufacturing method of hollow structural member of any one of the preceding claims, wherein the functional means is at least one selected from the group consisting of conductive member, magnetic member, and antibacterial member.

10. A manufacturing method of hollow structural member of claim 9, wherein the magnetic substance is at least one selected from the group consisting of ferrite, magnetic metal and magnetic alloy.

11. A hollow structural member of claim 9, wherein the magnetic member is a layer in a thickness of not less than 1 micrometer.

12. A manufacturing method of hollow structural member of claim 9, wherein the conductive substance is composed of at least one selected from the group consisting of silver, copper, brass, iron, zinc, aluminum, nickel, stainless steel, and carbon.

13. A manufacturing method of hollow structural member of claim 9, wherein the antibacterial member is at least one selected from the group consisting of antibacterial zeolite, chitosan, tannin, and tropylon.

14. A manufacturing method of hollow structural member of any one of the preceding claims, wherein the substance having the function is at least one of powder and fiber.

15. A manufacturing method of hollow structural member of any one of the preceding claims, wherein the substance having the function is a paint.

16. A manufacturing method of hollow structural member of any one of the preceding claims, wherein the structural member is composed of an electrical insulating substance.

17. A hollow structural member of claim 16, wherein the structural member is composed of at least one selected from the group consisting of thermoplastic plastic, thermosetting plastic, rubber, inorganic matter, ceramics, and compound plastic containing filler.

18. A manufacturing method of hollow structural member of any one of the preceding claims, wherein the structural member is a compound plastic containing at least one magnetic filler and conductive filler.

19. A manufacturing method of hollow structural member of any one of the preceding claims, wherein the hollow part is composed of a plurality of holes.

20. A hollow structural member of claim 19, wherein the holes have different sizes, and holes corresponding to the position receiving a large load from outside are smaller in size.

21. A hollow structural member of claim 19, wherein walls isolating the holes have different thicknesses, and the walls corresponding to the position receiving a large load from outside are larger in thickness.

22. A hollow structural member of any one of the preceding claims, wherein the hollow part occupies a volume in a range of 20% to 90%.

23. A manufacturing method of hollow structural member of any one of claims 19 to 22, wherein the plurality of holes are composed of at least one of independent holes and continuous holes.

24. A manufacturing method of hollow structural member of any one of the preceding claims, wherein the structural member contains a base part having an elastic function at its outside.

25. A hollow structural member of any one of the preceding claims, wherein the structural member is a plate.

26. A manufacturing method of hollow structural member of any one of the preceding claims, wherein the step of injecting gas into the material to form a hollow part forms a plurality of holes in the material.

27. A manufacturing method of hollow structural member of claim 26, wherein the plurality of holes are formed as being mutually isolated by the partition walls in at least one form selected from the group consisting of cross form, Y form and tee form.

28. A manufacturing method of hollow structural member of claim 26, wherein the plurality of holes are mutually isolated by concentric partition walls.

29. A manufacturing method of hollow structural member of claim 26, wherein the plurality of holes are mutually isolated by radial partition walls.

30. A manufacturing method of hollow structural member comprising:

(a) a step of forming a first structural member having a first half for forming a portion of a hollow part, by using a first die having a first fixed die and first movable die,
(b) a step of forming a second structural member having a second half for forming a portion of the hollow part, by using a second die having a second fixed die and a second movable die,
(c) a step of forming a first functional means inside of the first half,
(d) a step of forming a second functional means inside of the second half,
(e) a step of moving the second movable die to the first fixed die, thereby combining the first structural member having the first functional means and the second structural member having the second functional means so as to form the hollow part by the first half and second half, and forming the first structural member and second structural member into one body so as to form a third structural member, and
(f) a step of taking out the third structural member containing the first functional means and the second functional means formed inside of the hollow part, from the first fixed die and the second fixed die.

31. A manufacturing method of hollow structural member of claim 30, wherein the functional means is at least one selected from the group consisting of conductive member, magnetic member, and antibacterial member.

32. A manufacturing method of hollow structural member of claim 30, wherein the structural member is a compound plastic containing at least one of magnetic filler and conductive filler.

33. A manufacturing method of hollow structural member of claim 30, wherein the hollow part is composed of a plurality of holes.

34. A manufacturing method of hollow structural member of claim 30, wherein the plurality of holes are formed as being mutually isolated by the partition walls in at least one form selected from the group consisting of cross form, Y form and tee form.

35. A manufacturing method of hollow structural member of claim 30, wherein the plurality of holes are mutually isolated by concentric partition walls.

36. A manufacturing method of hollow structural member of claim 30, wherein the plurality of holes are mutually isolated by radial partition walls.

37. A manufacturing method of hollow structural member of claim 30, wherein structural member contains a base part having an elastic function at its outside.

38. A hollow structural member comprising:

a structural member having a hollow part, the structural member being composed of holes mutually isolated by partition walls in at least one shape selected from the group consisting of cross form, Y form, tee form, concentric form, and radial form, and
a magnetic member or antibacterial member disposed on the inside surface of the hollow part.

39. A hollow structural member of claim 38, wherein the magnetic member is composed of at least one selected from the group consisting of ferrite, magnetic metal, and magnetic alloy.

40. A hollow structural member of claim 38, wherein the antibacterial member is at least one selected from the group consisting of antibacterial zeolite, chitosan, tannin, and tropylone.

41. A hollow structural member of claim 38, wherein the structural member is composed of compound plastic containing powder in balloon form in order to reduce the weight.

42. A hollow structural member of claim 38, wherein the structural member contains at least one selected from conductive substance and magnetic substance.

Fig. 1

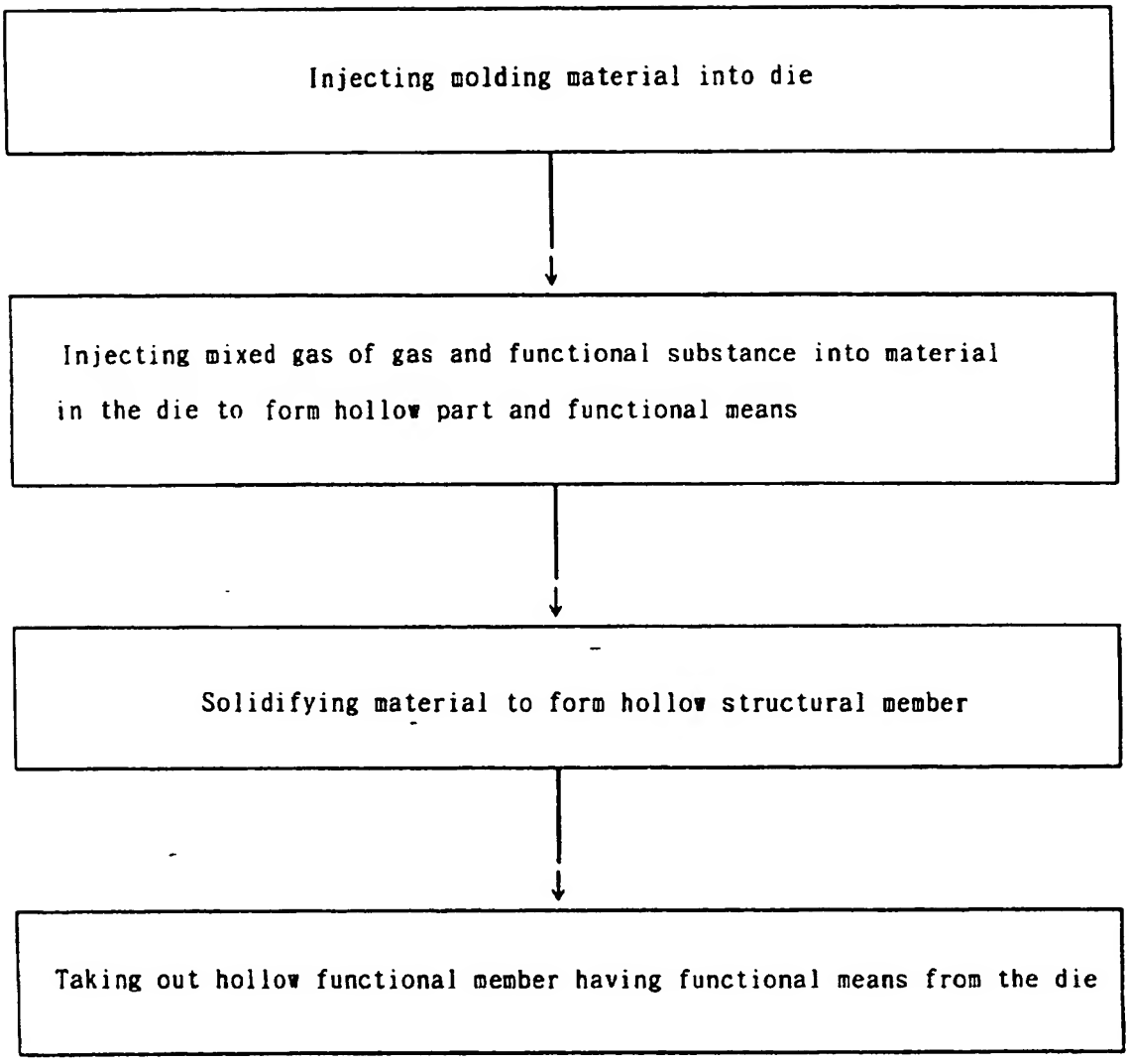


Fig. 2

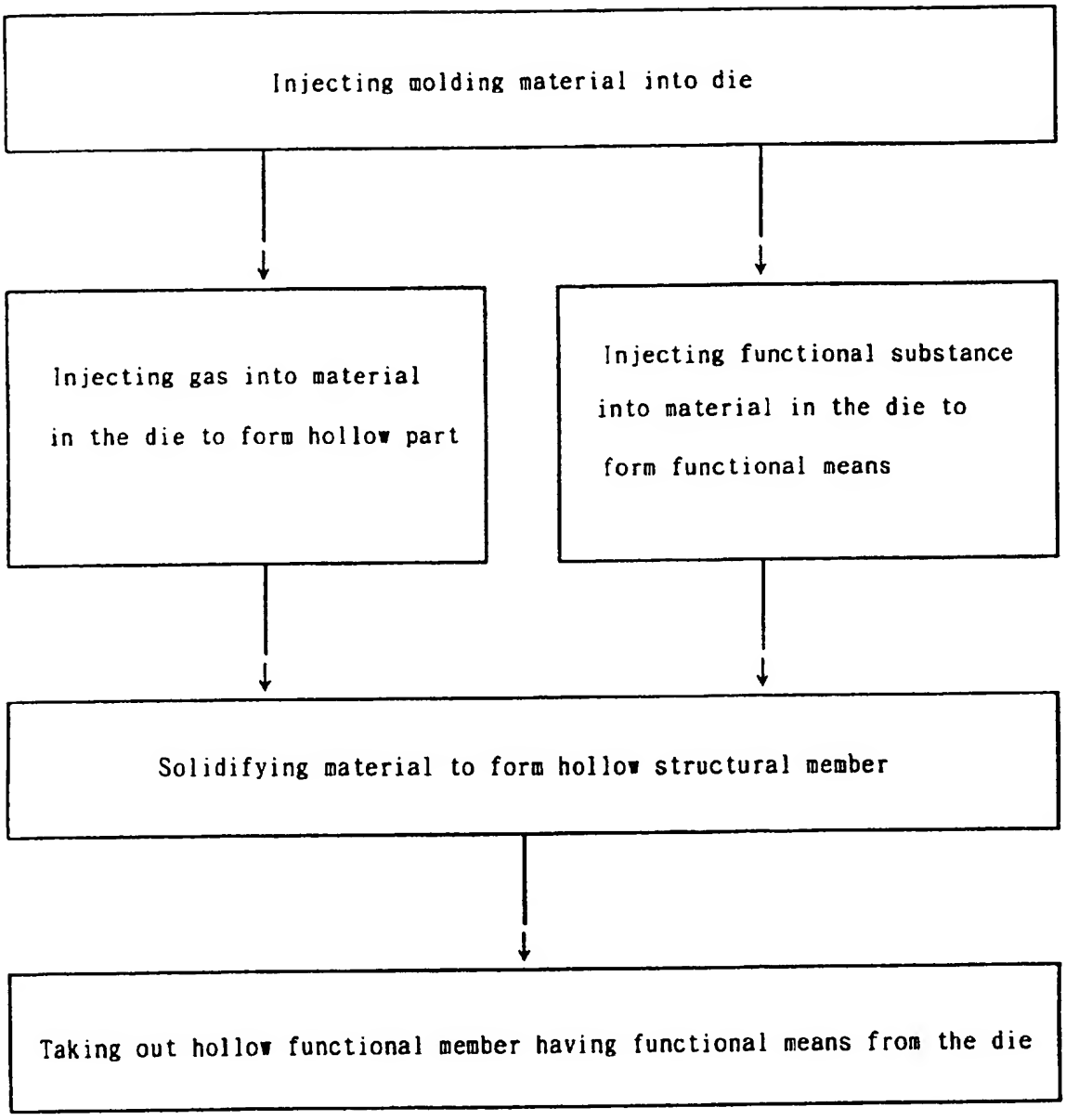
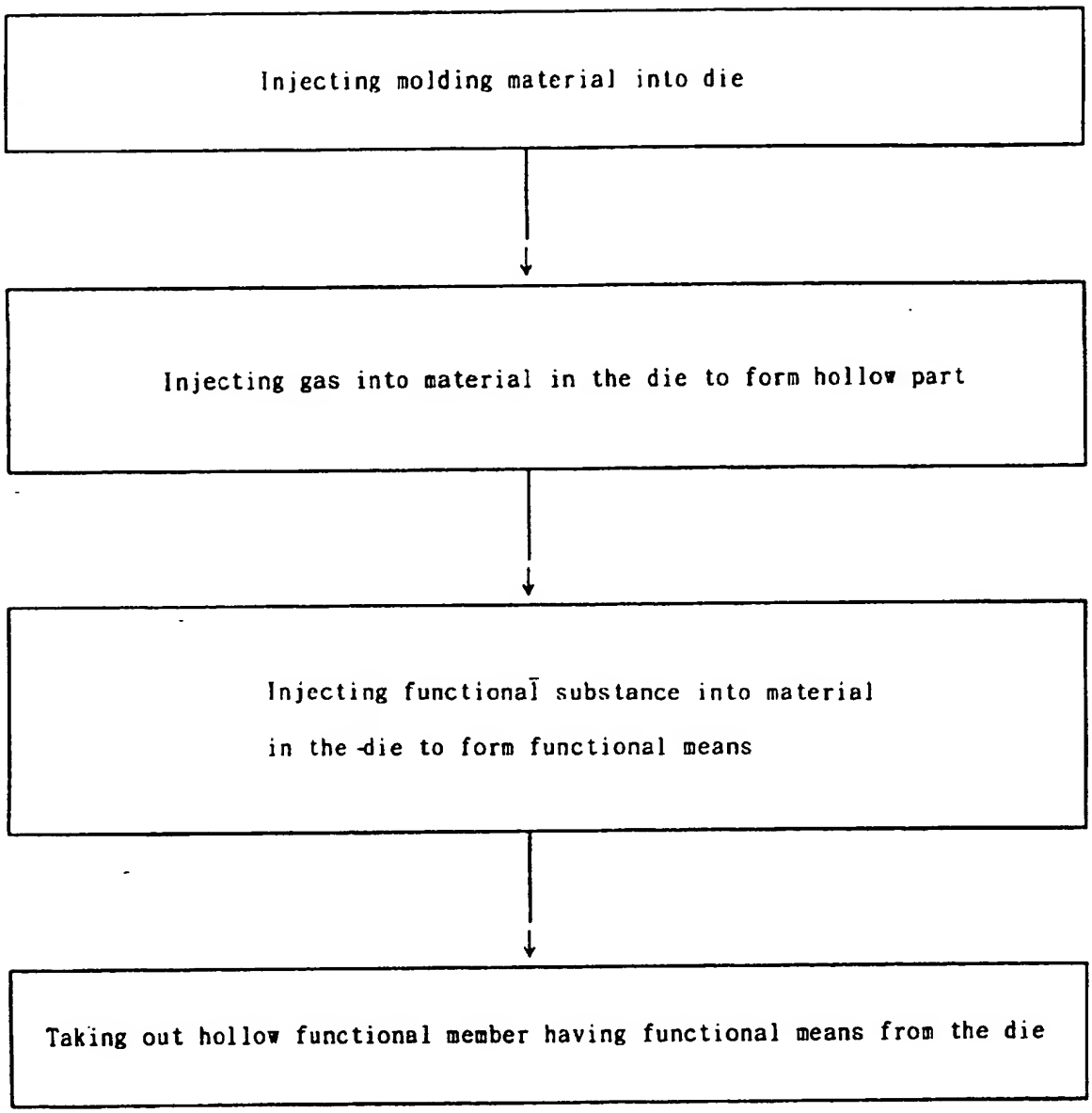

Injecting molding material into die
Injecting gas into material in the die to form hollow part
Injecting functional substance into material in the die to form functional means
Solidifying material to form hollow structural member
Taking out hollow functional member having functional means from the die

Fig. 3



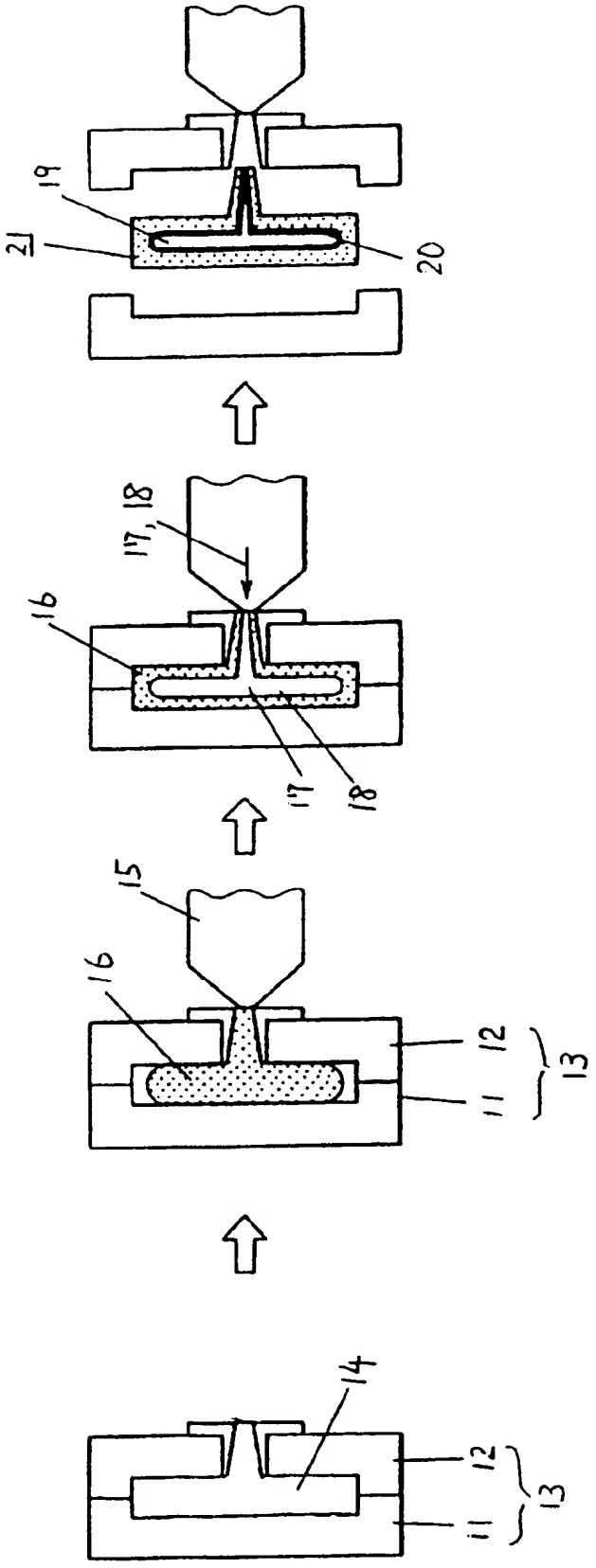


Fig. 4

Fig. 5

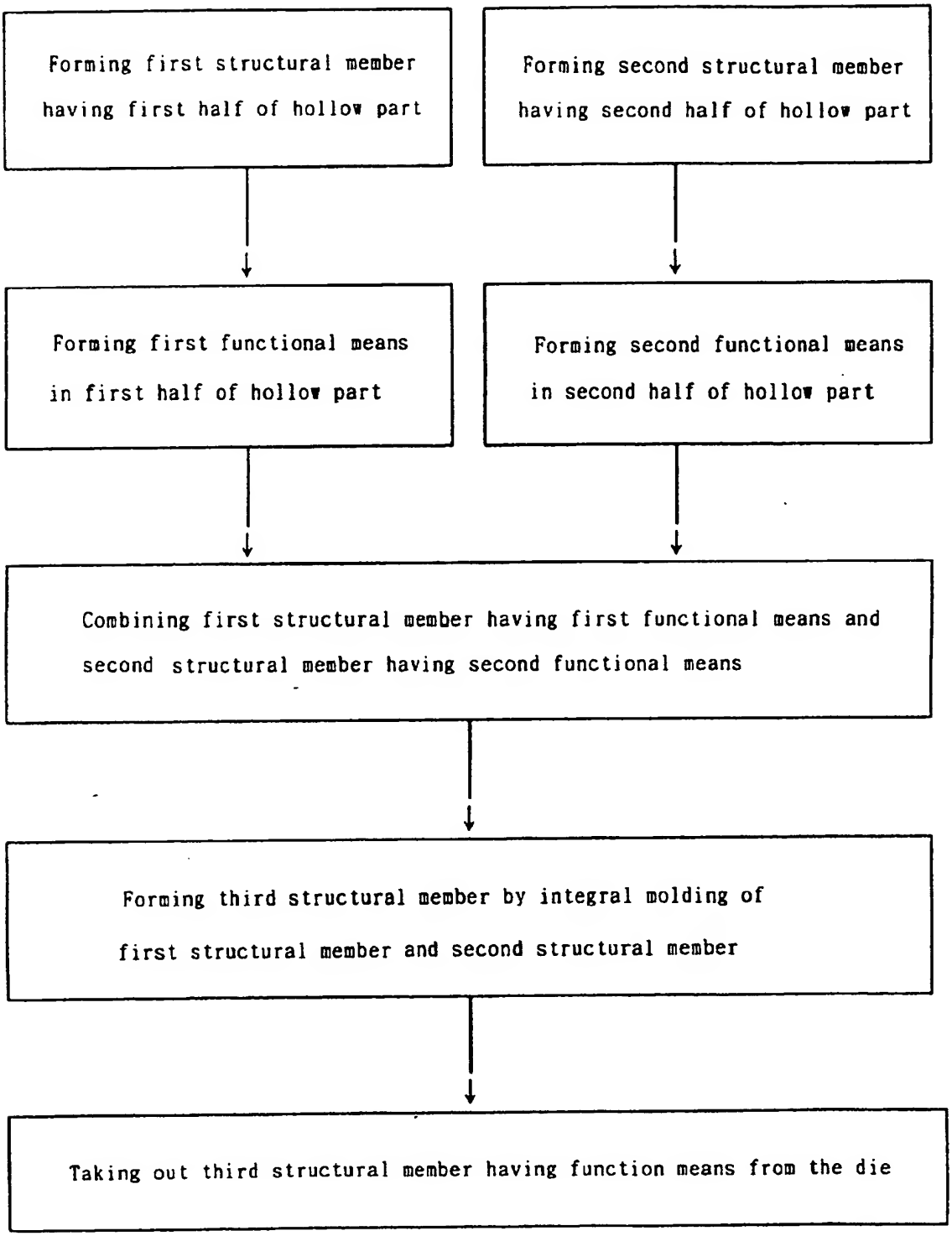


Fig. 6A

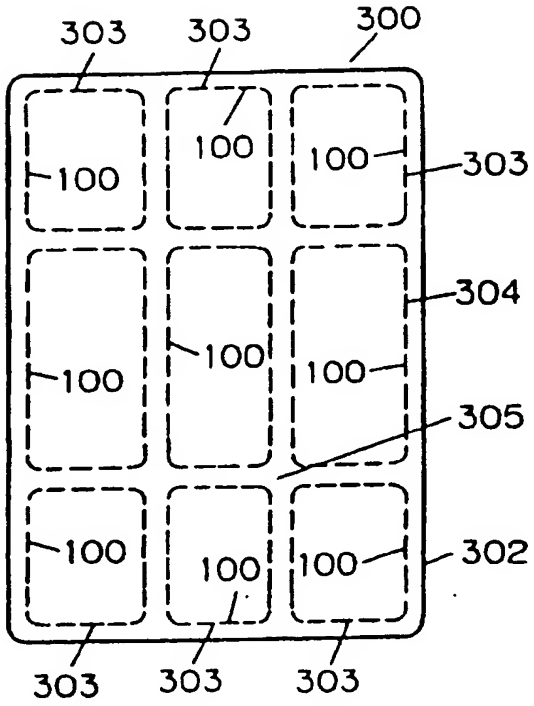

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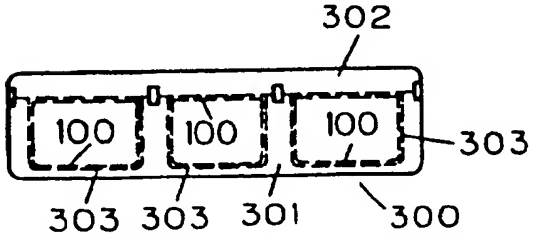
Fig. 6B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300

Fig. 6C

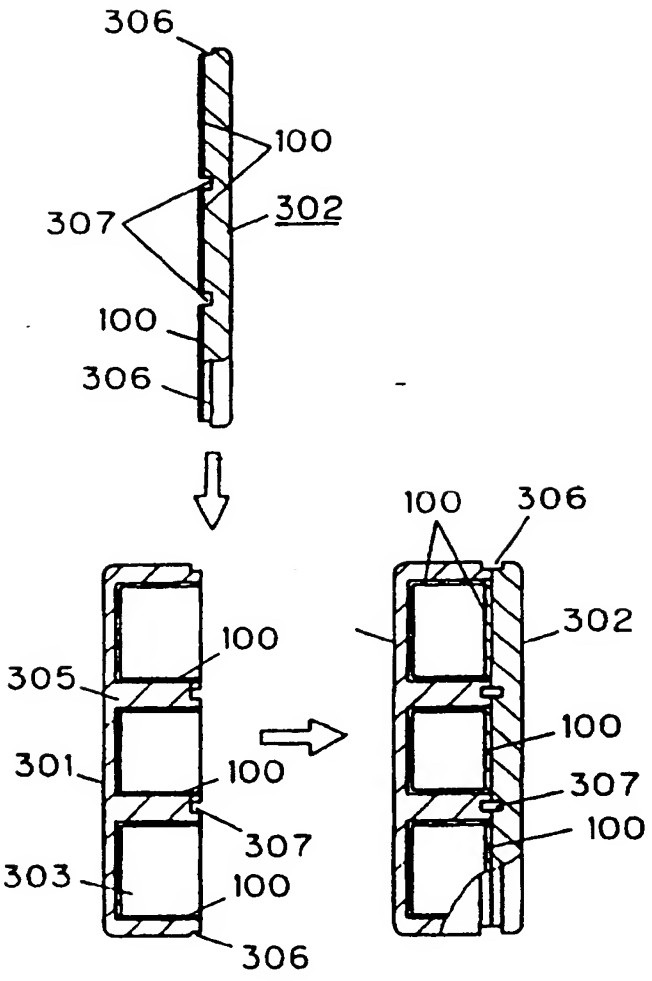


Fig. 6D

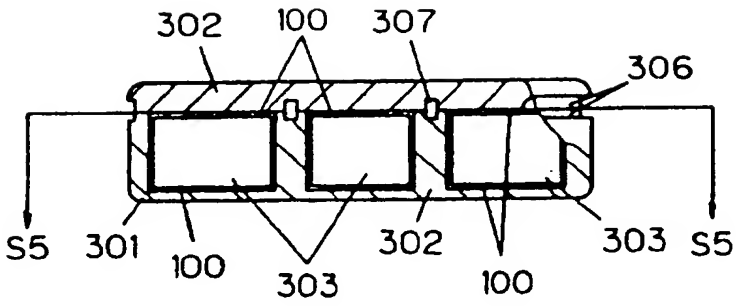


Fig. 6E

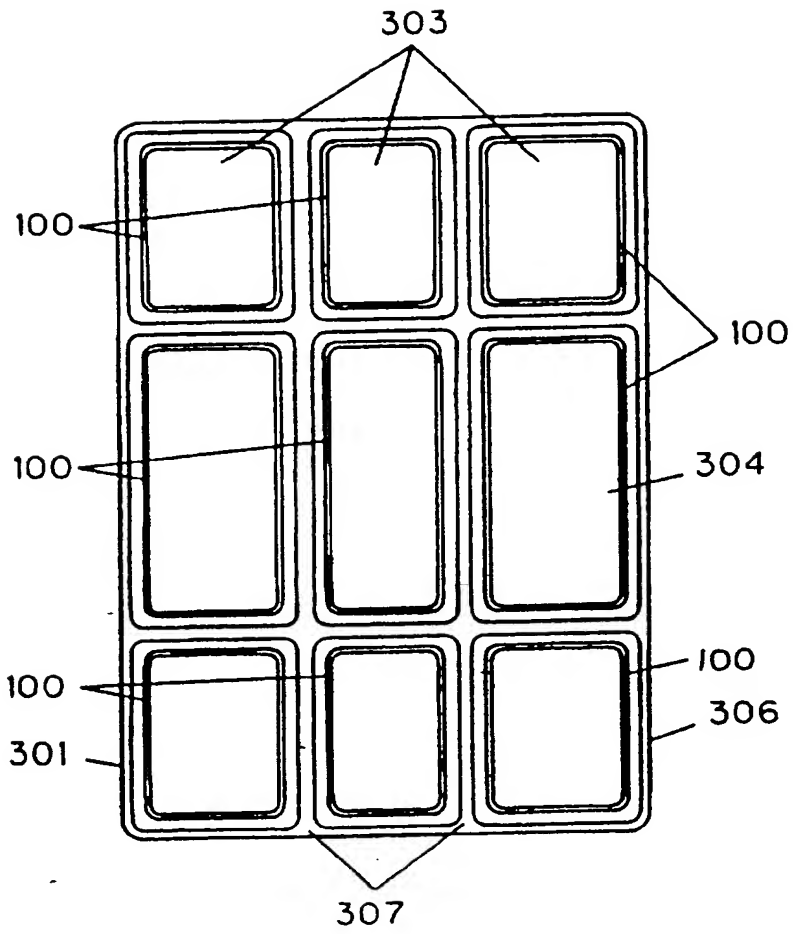


Fig. 7

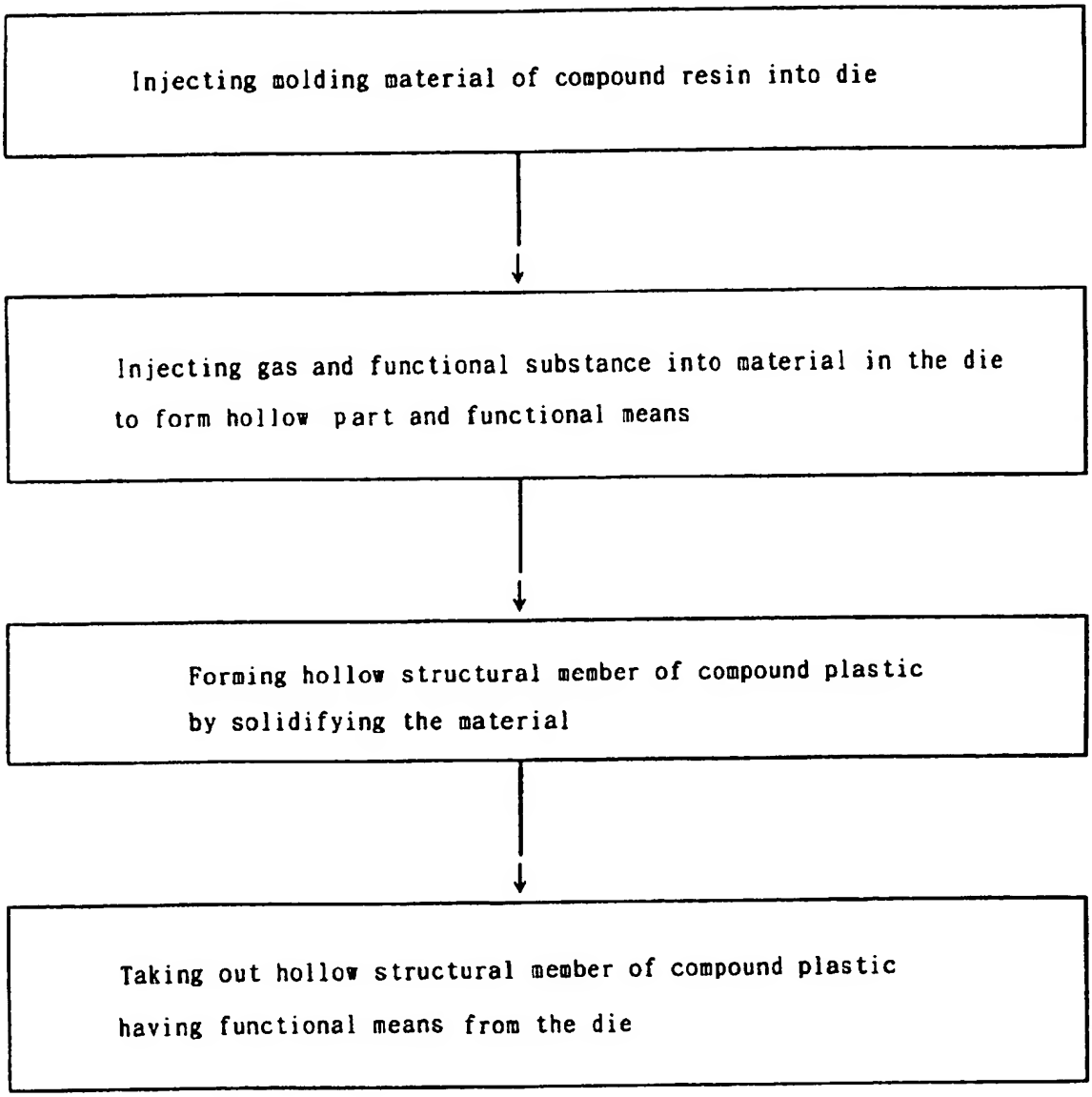

Injecting molding material of compound resin into die
Injecting gas and functional substance into material in the die to form hollow part and functional means
Forming hollow structural member of compound plastic by solidifying the material
Taking out hollow structural member of compound plastic having functional means from the die

Fig. 8

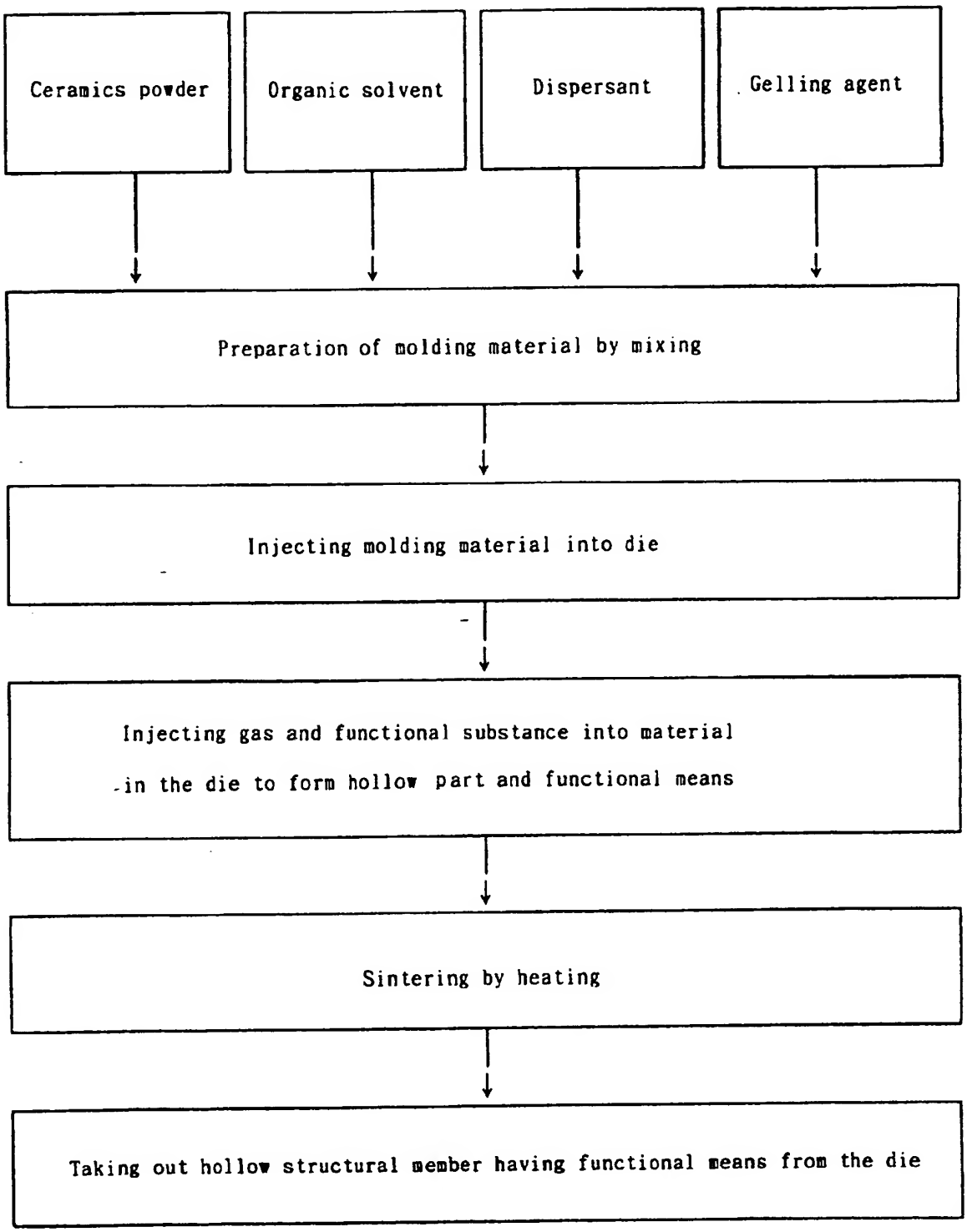


Fig. 9

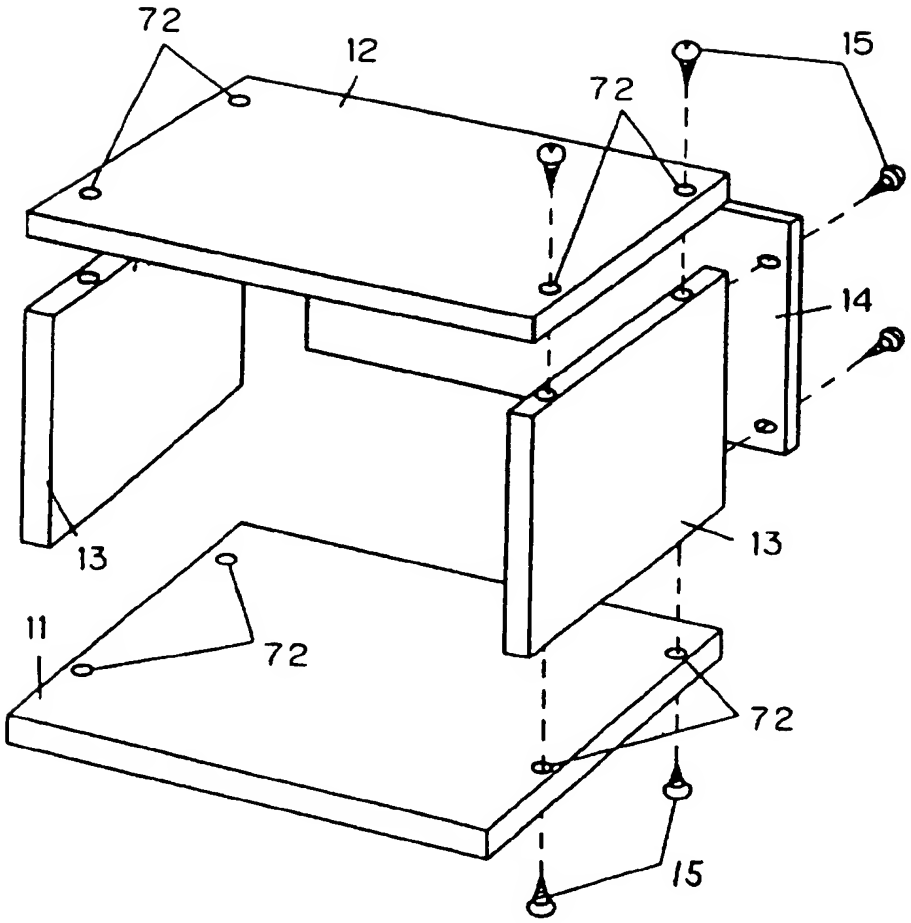


Fig. 10A

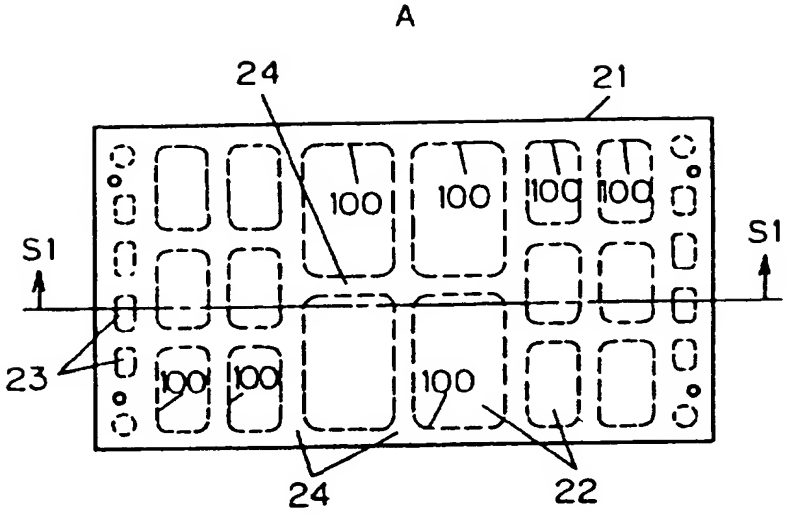


Fig. 10B

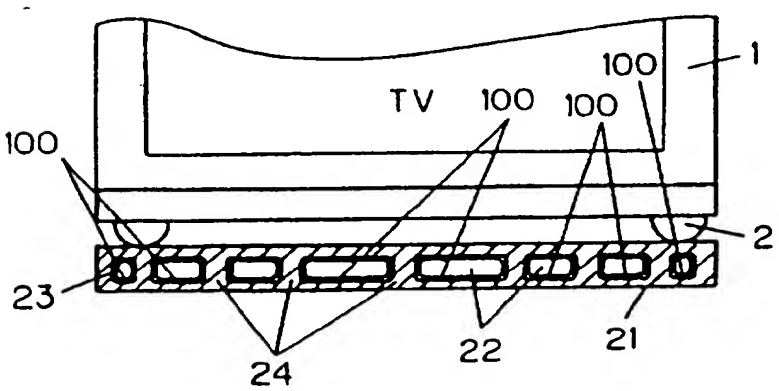


Fig. 11A

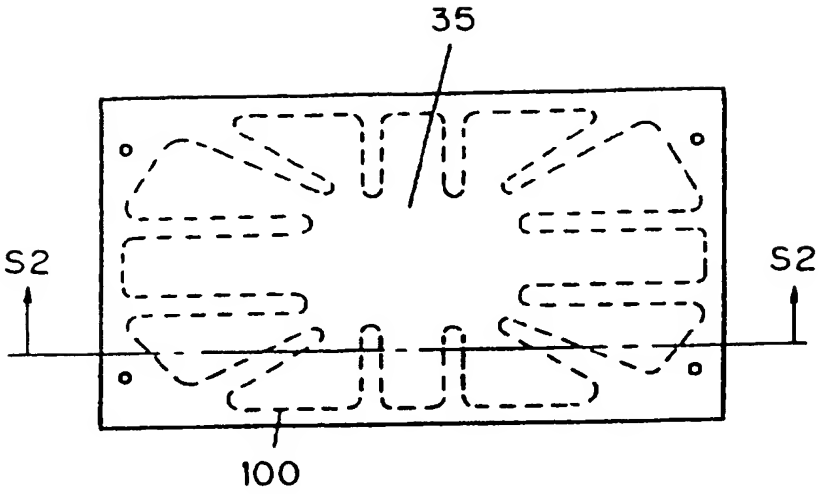


Fig. 11B

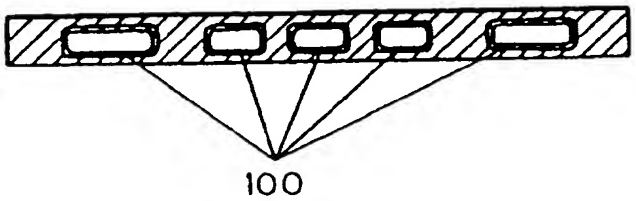


Fig. 12A

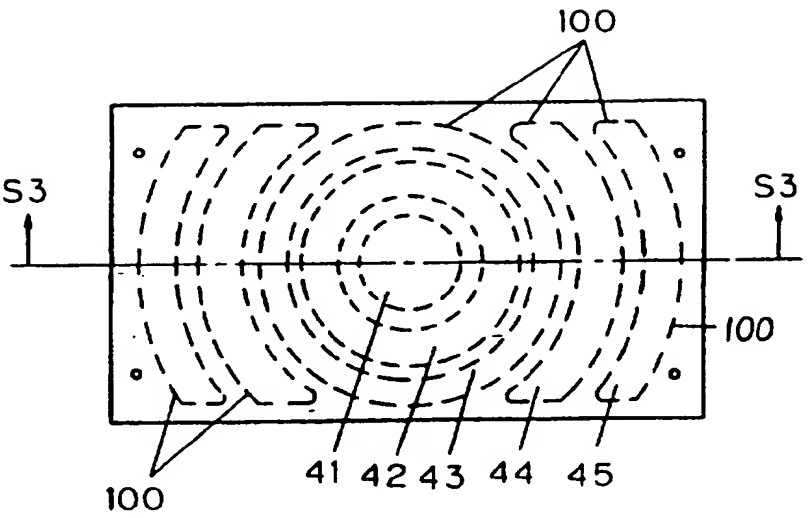


Fig. 12B

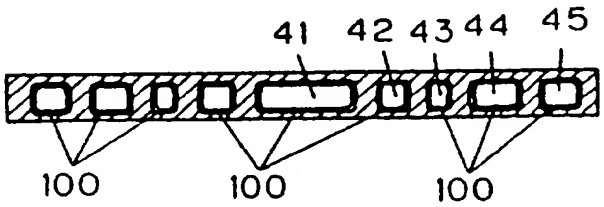


Fig. 13A

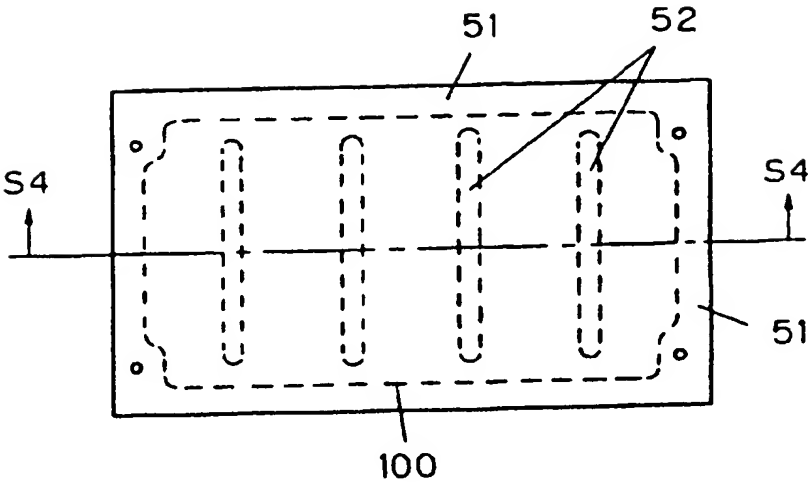


Fig. 13B

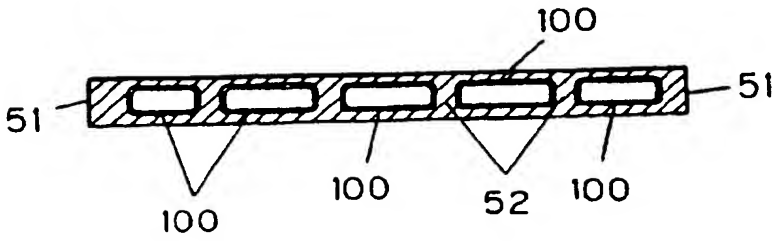


Fig. 14A

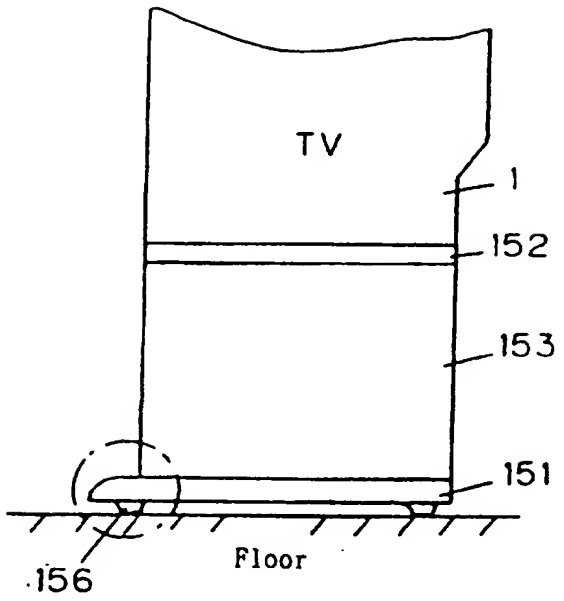
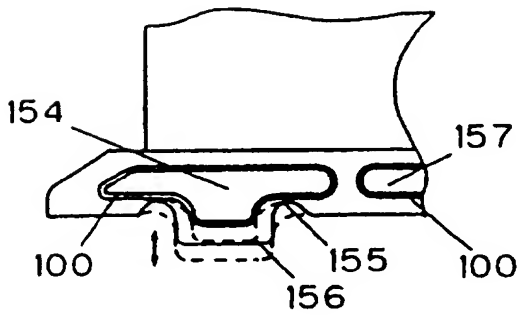


Fig. 14B



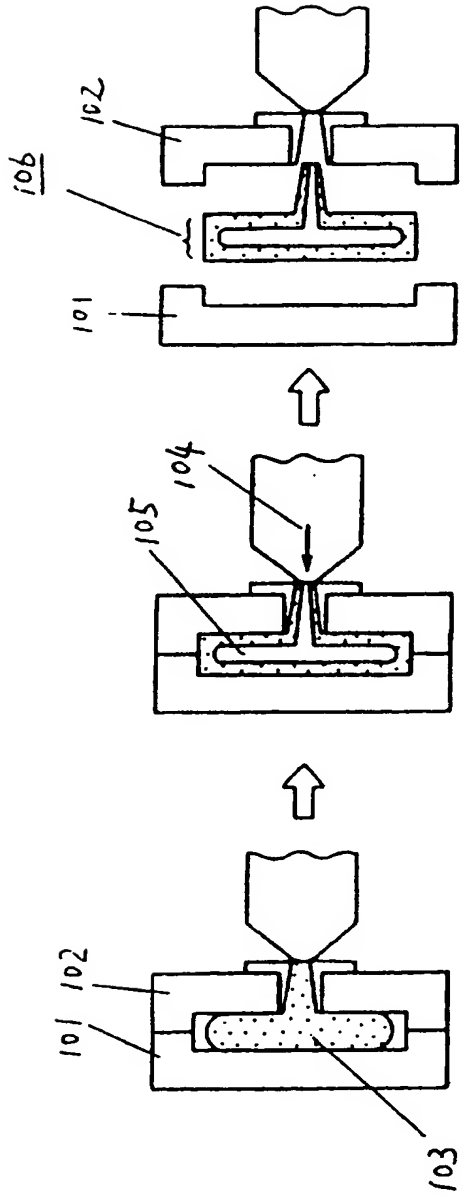
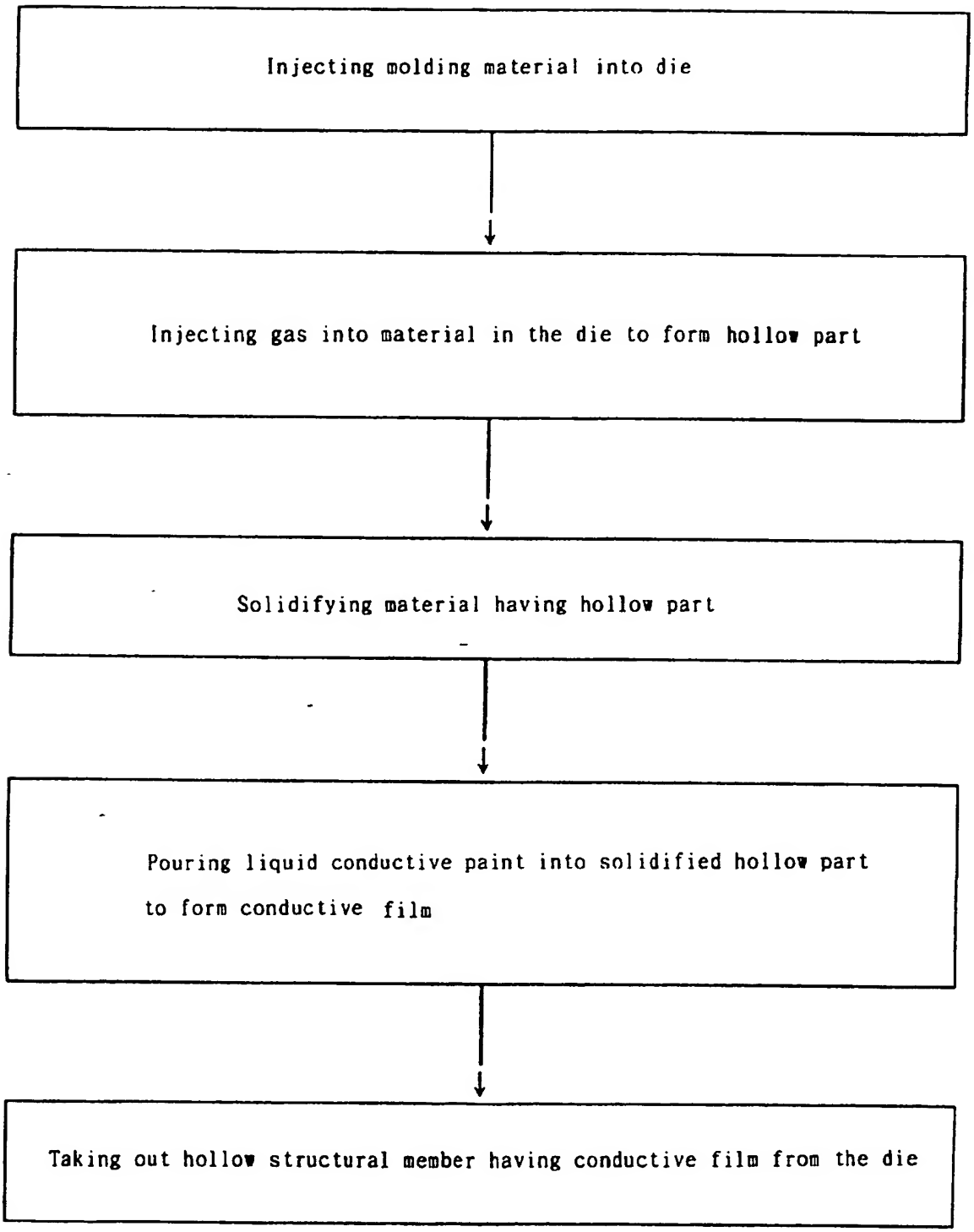


Fig. 15 PRIOR ART

Fig. 16 PRIOR ART



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 30 6760

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	DE-A-42 40 017 (WOCO FRANZ-JOSEF WOLF & CO) 1 June 1994 * column 3, line 61 - column 4, line 15 *	1-5 18-29	B29C45/17 B29C45/00 B29C37/00 B29C69/00
X	PATENT ABSTRACTS OF JAPAN vol. 17 no. 664 (M-1523) ,8 December 1993 & JP-A-05 220777 (OKASHIRO KANAGATA KASEI KK) 31 August 1993, * abstract *	1-5,8	
Y A	DE-A-42 02 306 (MATSUSHITA ELECTRIC IND CO LTD) 6 August 1992 * the whole document *	19-29 30,33, 34,38	
Y A	GB-A-2 218 937 (NIPPON STEEL CORP.) 29 November 1989 * the whole document *	18 32,42	
Y A	PATENT ABSTRACTS OF JAPAN vol. 7 no. 250 (M-254) [1395] ,8 November 1983 & JP-A-58 134721 (ARON KASEI KK) 11 August 1983, * abstract *	18 32,42	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B29C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 January 1996	Bollen, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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